

# An Air-Fuel Ratio Parametric Assessment on Efficiency and Cost of a Power Plant Steam Boiler

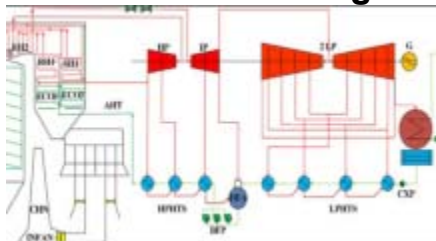
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## Abstract

The possibility of efficiently utilizing various fossil fuels that foster economic competitiveness is desirable in industrial boiler operations for uninterrupted and sustainable power generation. In this study, an oil-fired and gas-fired boiler designed to produce 653900 kg/h of superheated steam and 585450 kg/h of reheat steam at a temperature of 540 °C to generate electricity was simulated using HYSYS V 8.8. At a varied air-fuel mass ratio, the boiler's comparative performance when it fires natural gas and low pour fuel oil (LPFO) was conducted using a number of thermodynamic performance criteria. An exergy-based costing of running the boiler with both fuels was also carried out. For the samples of natural gas and LPFO considered in this study, an air-fuel ratio slightly above 16.1 should be adequate for the fuel combustion. Air-fuel ratio requirement below or far above 16.1 may portend malfunctioning boiler components or even an ineffective boiler design. Furthermore, at AFR of 16.1, it costs US \$4.04E-06/kJ to produce the superheated steam and the hot reheat stream when natural gas is fired while it costs US \$7.22E-06/kJ for the case of firing LPFO. These values reflect an improvement on the economic implications at AFR of 26.5, predominantly operational in the power plant. However, a form of subsidy (like a reduction in LPFO import duties) which lowers the overhead costs of power generation using LPFO will be required to make LPFO an attractive backup alternative to natural gas in instances where there is short or nonsupply of natural gas.

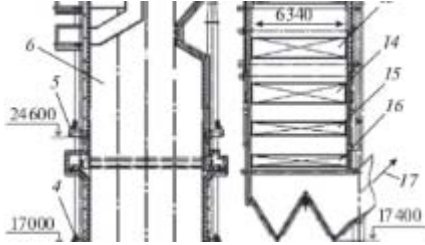
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## Ethics declarations

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### Conflict of Interest

The authors declare no conflict of interest.

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